gas, destroys the lining of the stack and melts off the dampers as fast as they can be replaced. The grate bars, the manufacturers state, never burn out, and the puddler's tools last about three times as long as they did when coal was used. In furnaces where the water necks cannot be used, they are compelled to use a jet of steam to lessen the heat.

Their production has increased about thirty-three per cent since they began to use gas, and the iron made commands from $10 to $20 per ton more than the same class of iron manufactured at the Apollo works, where they use coal, the iron being made from the same class of stock. These facts were communicated to the American Iron and Steel Association.

Scientific American.

MUNN & CO., Editors and Proprietors.

PUBLISHED WEEKLY AT

NO. 37 PARK ROW, NEW YORK.

O. D. MUNN. A. E. BEACH.

TERMS.

One copy, one year, postage included $3 20
One copy, six months, postage included 1 60

Club Rates:

Ten copies, one year, each $2 70, postage included $27 00
Over ten copies, same rate each, postage included 2 70

☞ By the new law, postage is payable in advance by the publishers, and the subscriber then receives the paper free of charge.

VOLUME XXXI, No. 19. [NEW SERIES.] *Twenty-ninth Year*

NEW YORK, SATURDAY, NOVEMBER 7, 1874.

Contents:

(Illustrated articles are marked with an asterisk.)

GAIN FROM THE USE OF FEED WATER HEATERS.

In an ordinary boiler, one pound of average coal will produce by its combustion between eight and nine thousand units of heat that are available for generating steam. Supposing the feed water to enter the boiler at a temperature of 32° Fah., each pound of water will require about 1,200 units of heat to convert it into steam, so that the boiler will evaporate between $6\frac{2}{3}$ and $7\frac{1}{2}$ pounds of water per pound of coal. Better results than these are often realized, especially in the case of tests, but the figures given above are believed to correspond with those of ordinary practice. The amount of heat required to convert a pound of water into steam varies with the pressure, as will be seen by the following table:

Units of heat required to convert one pound of water, at the temperature of 32° Fah., into steam at different pressures:

Pressure of steam in pounds per sq. inch, by gage.	Units of heat.	Pressure of steam in pounds per sq. inch, by gage.	Units of heat.
1	1,148	10	1,155
20	1,161	30	1,165
40	1,169	50	1,173
60	1,176	70	1,178
80	1,181	90	1,183
100	1,185	110	1,187
120	1,189	130	1,190
140	1,192	150	1,193
160	1,195	170	1,196
180	1,198	190	1,199
200	1,200		

If the feed water has any other temperature, the heat necessary to convert it into steam can easily be computed. Suppose, for instance, that its temperature is 65°, and that it is to be converted into steam having a pressure of 80 pounds per square inch. The difference between 65 and 32 is 33; and subtracting this from 1,181 (the number of units of heat required for feed water having a temperature of 32°), the remainder, or 1,148, is the number of units for feed water with the given temperature.

In the use of an ordinary non-condensing engine, in which the steam is exhausted directly into the atmosphere, each pound of steam, as it escapes, carries off the greater part of the heat that it has received in the boiler. This can be rendered plain by an example: Suppose the feed water enters the boiler at a temperature of 70°, that the pressure of steam is 90 pounds per square inch, and that the back pressure in the cylinder, under which the steam is exhausted, is 1 pound per square inch:

Temperature of feed water	70
Subtract	32
Difference	38
Units of heat required to convert 1 pound of water at 32° into steam at 90 pounds pressure	1,183
Subtract	38
Units of heat required to convert 1 pound of water at 70° into steam of 90 pounds pressure	1,145
Units of heat in 1 pound of steam at 1 pound pressure, from water at 32°	1,148
Subtract	38
Units of heat imparted to feed water, that are carried off by each pound of exhaust steam	1,110
Multiply this by 100	111 000
Divide by 1,145	96 941

which is the percentage of the heat, imparted to the feed water, that is carried off by the exhaust steam.

There remains, then, only about 3 per cent of the heat, imparted to the water by the combustion of the coal, that is utilized in the engine. This is a rather serious consideration for the steam user, who may figure up his account with the boiler and engine somewhat after this manner: One ton of coal costs $6.50, and evaporates, by its combustion, 15.000 pounds of water, at a cost for fuel of $0.00043 + per pound. When the steam resulting from the evaporation of this water is used in the engine, 96·94 per cent of the heat imparted to it by the fuel is exhausted into the air. This is the same as throwing away 14,541 pounds of the water that has been evaporated, leaving 459 pounds for useful work, so that really each pound of water used in the engine costs $0 014 +. There are very many engines running to-day to which this account will apply, engines that are sending into the air nearly all the heat imparted to the water by the fuel. We showed, in a preceding article, how considerable saving would generally result by attaching condensing apparatus to a non condensing engine. This cannot always be done, however; but there are means by which some of the heat carried off by the exhaust can be utilized. The most obvious method is to turn the exhaust steam into vessels through which the feed water passes, so that some of its heat may be imparted to the water, which will then require the consumption of less fuel for its conversion into steam. There are a number of heaters in the market which are guaranteed by their manufacturers to deliver the feed water into a boiler at the temperature of 212°, and we can state from our own experience that this is not an uncommon result, while a temperature of at least 200° should be realized from the use of any good heater. It may be profitable to consider the effect of attaching such a heater in the case previously cited. The feed water will then enter the heater at a temperature of 70°, and be delivered into the boiler at a temperature of 200°, having had its temperature increased 130° by the exhaust steam, which has lost a corresponding amount of heat. Each pound of water will require 1 015 units of heat for its conversion into steam of 90 pounds pressure, instead of 1,145 units, which were needed when the heater was not in use. This gives a gain of 130 units of heat for each pound of water evaporated, being 11 35 + per cent less heat than was required when the feed water was pumped into the boiler at a temperature of 70°. Each pound of exhaust steam, also, instead of carrying off 1,110 units of heat into the air, will only take 980, or 11 71 + per cent less than it formerly did. The account previously given will now figure up as follows:

The combustion of one ton of coal will evaporate about 16,900 pounds of water, at a cost of $0 00038 + per pound. In the engine, an amount of heat corresponding to about 16,300 pounds of the steam is thrown away in the exhaust, leaving 600 pounds for useful effect, at a cost of $0.0108 + per pound.

These examples, which correspond well with cases in ordinary practice, will enable our readers to estimate with tolerable accuracy the results that will be realized from attaching a heater in any given instance. It will be observed that, in the case supposed, no allowance was made for increased back pressure by the use of the heater. This was because the hypothetical heater was properly designed. A good heater does not increase the back pressure in the piston. There are many forms of the apparatus, however, that offer so much resistance to the escape of the exhaust steam, as to more than neutralize the gain that would otherwise be derived from their use. It is easy to see, for instance, that if the introduction of a heater increased the heat of the feed water 10 per cent, but also increased the back pressure so as to call for the expenditure of 12 per cent more fuel, the arrangement would be anything but economical.

A SPECIAL EDITION OF THE SCIENTIFIC AMERICAN.—ONE HUNDRED THOUSAND COPIES.

We shall, during the coming month of December, issue a special edition of the SCIENTIFIC AMERICAN, aggregating one hundred thousand copies, which will be gratuitously circulated among manufacturers of all kinds, machinists, mill owners, and, in brief, representatives of all industries in the United States and in Canada. At considerable outlay of time and expense, we have procured a list of one hundred thousand names, embracing the leading business men of the above important classes; and to each individual a copy of the SCIENTIFIC AMERICAN, enclosed in a separate wrapper and prepaid, will be mailed. The item of postage alone will thus cost the large sum of two thousand dollars, and the issue will find its way into every post office in the country.

Our motive for printing this extra edition, at an outlay of some six thousand dollars we do not desire to conceal, nor could we do so even if such were our wish. Our aim is to increase our subscription list; and in pursuance of this object, we take such means as will enable others beside ourselves to derive benefit from the enterprise, in direct proportion to the amounts they invest in its furtherance. To this end, therefore, we propose to admit a few advertisements. It will readily be apprehended that, since the publishers are distinctly pledged to print the large special edition above noted, and to mail the same (pre-paid) to names selected with care and judgment, every person having goods, productions, or ideas to bring to the notice of the class above mentioned is here furnished with the means. Moreover, it should be remembered that the names to which we refer are not those of our regular subscribers, but of business men not accessible through the ordinary newspaper channels.

We would direct especial attention to the fact that, although a circulation of 100,000 copies is guaranteed, there is every probability that this will be greatly exceeded. Our offer of last year included a circulation of but 60.000; but before we had supplied the demand, 120,000 copies were printed and mailed. For this immense excess, we imposed no extra charge upon our advertisers. The same course will be adopted this year. The extra benefit is given freely to those firms who send us advertisements for the special edition.

To the enterprising manufacturers and inventors who advertise in our regular columns, and indeed to everybody at all conversant with the advantages of a good medium, we need not point out the benefits to be derived from our proposition. For further particulars, see advertisement on another page.

COST OF TUNNELS.

"Among the various plans for disposing of the Jones' Falls stream or improving its channel, which have been presented to the council committee, is one by J. E. Sudler, civil engineer, proposing to divert it by a tunnel from a point beyond the city across to the valley of Gwynn's Falls, and thus throw its waters into the middle branch of the Patapsco, or Spring Gardens. This tunnel would pass in good part under Druid Hill Park, and through a rock formation which, it is believed, lies beneath all the hills in that quarter. Never having looked to diversion in that direction, and without pretending to have examined into or formed any judgment in the premises (the plan lately suggested by the mayor in his special message to the council for improvement within the city being still pending), it may yet be worth while to inquire into what has been the cost of like tunneling, accomplished in other parts of the world. The aggregate cost of this tunnel for Jones' Falls, the length of which is 16,000 feet, is put by its author at $2,800,000, or $145 per lineal foot, which is a fraction over $2 per cubic yard. With regard to other tunnels already in existence, their cost is given as follows: The great Mont Cenis tunnel cost about $800 per lineal foot, including equipment of road, etc. The Kilsby double track railroad tunnel (England), in the construction of which very great difficulties were encountered from the tapping of quicksands, cost $262 50 per lineal foot. Bletchingly tunnel, for a double track railroad in England, cost $120. Terre Noire, on the Paris, Lyons, and Mediterranean railroad, cost but $50 per foot; and the very difficult Hauenstein tunnel, between Basle and Berne, Switzerland, cost $133 per lineal foot. The Hoosac tunnel, through a formation of mica slate and quartz, with working shaft upwards of 1,000 feet in depth, cost $360 per lineal foot.

These tunnels were all completed several years ago, and the cost per cubic yard of material excavated varies from $1 50 to $14. The difficulties met with in their execution have led to the invention of improved apparatus, by the use of which the cost of boring, drilling, etc., is reduced from 100 to 300 per cent. The diamond boring machine was thoroughly tested by Captain Beaumont, R. E., in Lancashire and Cumberland. At Stoughton, the borer reached a depth of 689 feet in two months, that could not have been got at in less than two years by hand labor. In the Clifton tunnel, Bristol Port and Channel Dock Railroad, in hard mountain limestone, the drills advanced at the rate of two inches per minute—outside diameter of boring, two inches. The machine advanced at about five times the speed that could be attained by as many men as could find room to work at a heading. The motor is compressed air. Dynamite is used for blasting, and found to answer admirably. With the aid of these machines the work of tunneling through the hardest rock presents no difficulties of any extraordinary character, and may be executed at a cost very little, if any, greater than the excavation of the same material in open cutting."—*Baltimore Sun.*

To the above, may be added the cost of that portion of the Underground Railway, in New York city, now nearly completed, on Fourth Avenue, between 44th street and Harlem river at 133d street, a distance of about 4½ miles. This railway has four tracks, and consists chiefly of open cuts and tunnels, but includes a massive stone viaduct 60 feet wide, 30 feet high at greatest elevation, and about 6,500 feet long. The open cuts are about 66 feet wide, walls included, and from 10 feet to 14 feet deep, spanned at the street crossings by splendid iron bridges. The tunnels are of three kinds, brick arches, flat iron beam tunnels, and rock tunnels. They consist of three parallel tunnels, one central and two separate side tunnels, all occupying a space under the streets of about 70 feet in width by 30 feet in depth. At about every half mile are roomy passenger stations and waiting rooms, also constructed underground, lighted from the sidewalks. Altogether this is one of the finest examples of underground railway construction in the world. It has been in progress for the past two years, and will be finished in January next. The total contract price of this great work, including stations, bridges, ballasting, viaduct, tunnels, changes of water pipes and sewers, is $6 395,070, being at the rate of a little under $285 per lineal foot. Considering the large size, this is a very moderate cost; and for once the city of New York, which pays one half of the bill, has not been cheated or imposed upon.

We recently made a personal inspection of the work from beginning to end, carefully examined all the details of construction, and were much gratified to observe the extreme care taken to render every portion solid and enduring. We shall in our next commence a detailed account of the entire line, drawings for which have been kindly supplied to us by the officer in charge. These papers will be read with interest by civil engineers in all parts of the world, as they involve many practical examples of the most recent construction, executed under the supervision of individuals of eminence in the profession.

EXPLOSIVE WOUNDS FROM NON-EXPLOSIVE BULLETS

The use of explosive bullets in war is forbidden by international agreement. During the Franco-German war, the French were repeatedly accused of violating this humane compact; and the charge, though indignantly denied, seemed to be justified by the nature of the wounds which the German surgeons had to deal with. Where the ball entered, a small round aperture would be observed, while its course within the body would frequently be marked by a fearful shattering of bones, and its aperture of exit would show a ragged opening that one could thrust his fist in. Only by the explosion of the ball on striking the bone, it was thought, could such mutilation be possible. The accused have now the full though tardy satisfaction of having their innocence thoroughly established by German investigations.

In a paper read last year before the German Surgical Congress, Professor W. Busch, of Bonn, called attention to the fact that wounds such as had been attributed to explosive bullets were made by the Chassepôt bullet fired at short range. He explained the phenomenon by supposing that the ball became melted and broken up by forcible contact with the bone, and acted like a mass of shot on the parts beyond. That the ball would be heated by the sudden arrest of its motion, full or partial, could not be donbted; and the spreading of the ball in star shape when fired against an iron target was urged as proof that the heating may be sufficient to melt the lead.

Dr. Augustus Küster was not satisfied with this explanation, and has since been conducting experiments on gunshot wounds in animals at the Royal Military School at Spandan, the results of which have been published in a late number of the *Berliner Klinische Wochenschrift*. In making the experiments, a large target was placed behind the animals (horses and wethers), so that the condition of the bullets could be observed after their passage through the bodies. The distances were five, twenty, one hundred, and eight hundred paces. The arms used were a muzzle-loading sporting rifle throwing a pointed bullet, the needle gun, and the Chassepôt, Mauser, and Henry-Martini rifles. The animals were first killed by a volley from all the weapons, and subsequently the carcases were used for further experiments. Omitting details of interest only to surgeons, the results of the investigation may be summed up as follows:

1. There is no essential difference in the action of bullets on the living and on the dead body. Heretofore the opinion has been that gunshot wounds are more extensive in the living than in the dead body, and that by the wound it can be told whether the injury was done before or after death—a position no longer tenable. Owing to the greater toughness of the skin of animals, the aperture of exit is not so large as in the human body; the destruction of the flesh and bones, however, is equally extensive.

2. The extent of the destruction is in inverse ratio to the distance, and in direct ratio with the initial velocity of the bullet. The sporting rifle made the simplest wounds. Then followed the needle gun, the Chassepôt, and the Mauser rifle, which produced frightful destruction of the bones and soft parts.

3. The destruction of the tissue is produced by the lead becoming heated and broken up, but without being melted. The bullet is mechanically divided, leaving the finer particles of lead in the recesses of the wound, while the fragments of larger size pass out along with pieces of shattered bone, flesh, etc. Most of the Chassepôt and Mauser bullets, which have the greatest initial velocity, passed through the animals' bodies reduced by one half or more, and greatly altered in shape, making on the target an irregular impression, surrounded by a crown of small pieces of lead, carrying fragments of bone, muscle, hair, etc. The wounds made at short range were frightful.

4. The injuries described are made only by bullets of soft lead. The Henry-Martini rifle stands alone in using a ball of hard lead, or lead mixed with tin in the proportion of twelve parts to one. The initial velocity of the ball thrown by this rifle is almost as great as that of the Mauser, yet the wound produced by it is very much smaller. It makes a clean hole through flesh and bone neither shattering the bone nor leaving splinters of lead in the course of the wound. In one case only did Dr. Küster find a Henry-Martini bullet much misshapen, and that time it remained sticking in a bone. On but one occasion, when fired at a hundred paces, did it fail to pass through the longest diameter of a horse, while the Mauser bullets frequently remained in the wounds, owing to the greater resistance they had to overcome in consequence of their greater misshapement.

Having shown that bullets of soft lead fired at short range act just like explosive bullets, and that a close combat with them can be nothing but a horrible butchery, Dr. Küster protests against their use; and as a duty to a brave opponent, he takes pains to say that the French stand thoroughly acquitted of the charge of having committed an act of unworthy and interdicted barbarity.

WHAT TEMPERATURE KILLS?

At the present stage of enquiry, the very important biological question whether life does or does not ever appear otherwise than as a product of antecedent life plainly hinges on the simpler question: What temperature kills? In other words, what degree of heat is certainly fatal to living matter? A boiled egg will not hatch, boiled seeds will not germinate; no animal or plant thus far experimented on has been found to survive exposure to boiling water. Yet the appearance of living forms within hermetically sealed flasks, the contents of which have been boiled ten minutes or more, has been observed by too many trustworthy witnesses to be longer doubted. The question to be settled is: Are there any forms of living matter, germs, seeds, or what not, that can endure 212° of temperature by Fahrenheit's scale? And if so, what higher temperature certainly kills them?

The first to attack the problem with scientific thoroughness and care was the acute and learned Abbé Spallanzani, something over a hundred years ago. At that time Needham was advocating the doctrine of spontaneous generation, on the strength of experiments similar to those which later investigations have made familiar. Spallanzani repeated the experiments, and found that the lower infusoria certainly would appear within closed vessels previonsly subjected to boiling heat. The organisms themselves were killed by a temperature of 108½° Fah. Unwilling to accept the conclusion arrived at by Needham, the Abbé assumed that the unknown germs of the infusoria must be able to withstand the higher temperature, and thereupon set to work to discover whether the difference in the capacity of resisting heat, imagined to exist in this case between parents and germs, could be justified by the establishment of similar differences in heat-resisting capacity between other parent organisms and their germs. By a careful series of experiments, he found that, while frogs and tadpoles perished at 111° Fah., frogs' eggs appeared in some cases to resist the temperature of 131° Fah., none, however, surviving 144½° or upwards. Aquatic salamanders and fish were likewise killed by water having the temperature of 111°. Silkworms' eggs and the eggs of the elm moth failed to germinate after being heated to 140° Fah. The developed worms died at 108½°. Leeches perished at 111°; the *nematoids* known as vinegar eels, at 113°; other aquatic worms at 111°, and water fleas at 107°. Thus, while about 110° Fah. sufficed to kill matured forms, their eggs were not killed under about 140° Fah.

Observations on seeds and plants were conducted in a similar manner, the water being heated slowly and the seeds and plants taken out as soon as the desired temperature was attained. Not one seed germinated after exposure to boiling water. Of the corresponding plants a few survived a momentary exposure to 156°, none the temperature of 167°. (The grades of heat experimented with differed for the most part by 5° Réaumur, or 11¼° Fah., so that the thermal death point was not precisely noted.)

From these experiments it was manifest that (1) eggs can endure a higher degree of heat than the animals from which they are derived: (2) a similar difference exists between plants and seeds: (3) seeds and plants resist higher grades of heat than eggs and animals. Not a single living thing, however, egg or seed, animal or plant, survived a brief exposure to a moist heat of 212° Fah.

To the dryness of seeds was evidently due their ability to withstand heat better than eggs. Certain eggs resemble seed in that they may be dried and yet develope after being placed in a suitable damp medium. Might not the germs of the lowest animalcules likewise withstand desiccation, and in a dry state excel seeds in power to bear heat, as the seeds excel eggs? Inasmuch as the germs in question were invisible and unknown, they could not be subjected then to the test of certain experiment; and on the ground of their hypothetical existence and power, Spallanzani was able to refuse assent to the probability of the germless origin of living matter in the cases under consideration.

Unfortunately for the panspermatist position, Spallanzani's assumptions are not merely not sustained but are positively contradicted by more recent investigations. Professor Burden Sanderson shows that, so far from being able to withstand desiccation, the germinal particles of *bacteria* are killed by simple exposure for three days to dry air of the low temperature of 104° Fah., and that the fully formed animalcules are deprived of their power of further development by thorough desiccation. Further, Dr. Charlton Bastian (who reviews this question of the thermal death point of matter very fully in the *Contemporary Review* for September) has shown that all direct experiment, on the power of *bacteria* and their germs to withstand heat, leads to the conclusion that they are both killed by a brief exposure to a moist heat of 140° Fah. Many investigators, working independently of each other, and often without reference to the origin of life question, coincide in showing that, with certain peculiar exceptions, the temperature of 140° Fah., with moisture, is fatal to living matter.

In very many, if not most, cases the death point is much lower. Thus according to the observations of Spallanzani, Max Schultze, and Kühne, simple aquatic organisms die under temperatures ranging from 104° to 113° Fah. According to Kühne, elements of the cold-blooded frog are killed at 104°. Stricker and Kühne agree in fixing the thermal death point of the tissue elements of warm-blooded man at 111°; that of the tissue elements of plants, according to Max Schultze and Kühne, is from 116½° to 118½°: while Spallanzani, Liebig, Tarnowski, and others find that eggs, fungus, spores, and *bacteria* germs are killed at temperatures between 122° and 140°.

The exceptional cases are the *confervæ* and allied organisms observed by Dr. Hooker in Sorujkund, flourishing in a hot spring of the temperature of 168° Fah.; others in water of 174°, as observed by Captain Strachey in Thibet; in 185°, as observed by Humboldt in La Grinchera; 190°, as observed by Dr. Bremer in California; and 208°, or 4° below the boiling point of water at sea level, as observed by Descloizeaux in Iceland.

"It is a well known physical fact," says the late Professor Wyman, commenting on the examples of life at high temperatures above given, "that living beings may be slowly transferred to new and widely different conditions without injury; but if the same change is suddenly made, they perish. In the experiments made in our laboratories, the change of conditions is relatively violent, and therefore liable to destroy life by its suddenness."

Even if it were possible for living organisms to withstand suddenly the temperature to which these exceptional growths have become inured through long periods of time, the difficulty attending the appearance of living forms, in hermetically sealed flasks which have been previously heated as high as 275° Fah., as recorded in Dr. Bastian's latest experiments, would not appear to be greatly lessened. The evidence is overwhelmingly against the survival of living matter after prolonged boiling, much less after exposure to a temperature sixty degrees higher.

SCIENTIFIC AND PRACTICAL INFORMATION.

WORKING MEN'S HEALTH.

From a report of Dr. Waller Lewis, a noted English physician, regarding the health of French working men, it appears that the percentage of deaths from consumption, in 1,000 cases collated, is for various trades as follows: Exposed to vegetable or mineral emanations, 176; to dust and fine particles, 145; sedentary occupations, 140; employed in close workshops, 138; exposed to hot and dry air, 127; requiring active muscular exercise, 89; requiring exertion of voice, 75; working in open air, 73; exposed to animal emanations, 60; the remainder being made up of persons working in a stooping posture, exposed to sudden movements of the arms, or exposed to watery vapors. Concerning the effect of various employments on the eyesight, it seems that the sense is injured by those working with polished metals, looking glasses, etc. The smallness of objects and intensity of direct or reflected light is also a cause of impaired vision; while astronomers who study the sun have become totally blind, and opticians who daily exercise and test spectacles, etc., engravers, watch makers, etc, are liable to amaurosis and amblyopia.

THE POPULATION OF CHINA.

Abbé David, who has recently devoted some years to the the exploration of Chinese territory and the study of the people, says that the estimate of statisticians that the total population of the Chinese Empire is but 100,000,000 souls is entirely incorrect. The error is due to the terrible ravages made in certain small political divisions, which have rebelled at times, and in which wholesale massacres have reduced the inhabitants to one half and in some cases one fifth their former numerical strength. The province of Kiangsi is, however, the least populated, and the average of each canton therein is 4,000 people. There are 4,345 cantons, making an approximate total of 17,380,000 inhabitants. Among the 18 provinces of the Empire, it is certain that several largely exceed Kiangsi in population; but taking the above given aggregate as a unit, there must be at least 300,000,000 individuals in the country.

ACTION OF SULPHURIC ACID ON LEAD.

From recent experiments by H. A. Mallard, it appears that acids below 61° Baumé, concentrate by boiling until they attain a temperature of 433° Fah., or that at which acids at 61° Baumé boil. They then attack lead, producing sulphurous acid and some sulphate of the metal. Acids above 61° Baumé and below 65·5° Baumé concentrate by ebullition up to 780° Fah., the boiling point of acids of the latter density, when they attack lead, producing sulphate of lead, sulphurous acid, and a little sulphur. Acids of 65 5° Baumé at 482° Fah. also attack lead, producing the results last mentioned.

THE EAST RIVER BRIDGE.—It is expected that in four weeks from this date the Brooklyn tower of the East River bridge will be completed. On October 24 a hight of 259 feet had been attained, and there were seven more courses, about 14 feet, of stone to be added. The anchorage on the Brooklyn side is also in a forward state.